Annual Project Summary

# Characterization of Subsurface Sediments for Liquefaction Hazard Assessment, Southern San Francisco Bay Area

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## NON-TECHNICAL SUMMARY

The objective of our study is characterize the distribution, thickness, and properties of the young sediments and overlying artificial fill within the southern Bay area. This information is ultimately required to produce maps showing areas underlain by sediments that may liquefy during an earthquake. These maps can then be used for emergency response, planning, engineering, and risk mitigation. Toward this ultimate objective, we currently are compiling and interpreting subsurface data, to produce a series of 1:24,000-scale interpretive, digital maps for the southern San Francisco Bay, including the densely populated Santa Clara Valley.

## INVESTIGATIONS UNDERTAKEN

Much of the urban development within the flatlands bordering the San Francisco Bay is underlain by Holocene sediments deposited during the last interglacial rise in sea level. In addition, development has encroached onto the Bay margins on artificially placed fill. These deposits and artificial fills are vulnerable to liquefaction and amplification of strong ground motions. Our ongoing study is characterizing the distribution, thickness, and geotechnical properties of Holocene sediments and overlying artificial fill within the southern Bay area.

We are compiling and interpreting subsurface data, over 1,800 subsurface boring logs to date (Figure 1), to produce 1:24,000-scale maps for the southern San Francisco Bay, including the Santa Clara Valley, that show the elevation of the buried top of Pleistocene deposits (the inferred base of liquefiable sediments), thicknesses of Holocene deposits, and thicknesses and composition of artificial fills along the bay margins. Our results contribute toward the characterization of three-dimensional distribution of potentially liquefiable sediments required for assessment of liquefaction hazard. In addition, the top of buried Pleistocene deposits represents a surface exposed prior to the rise of seawater through the Golden Gate at the beginning of the Holocene. These maps with the completed database will be completed by February, 2001.

## RESULTS

Contouring and reconstruction of this laterally extensive buried surface provides information on the subsurface structure and stratigraphy of basins in the southern Bay area. Our contour maps of the top of Pleistocene deposits show irregularities in the Pleistocene surface that may correspond to buried former stream channels and may record fault displacements. Our phased project plan builds on the approach employed by Helley (1990) to delineate the top of Pleistocene deposits in the Santa Clara Valley, within the southern part of our proposed San Francisco Bay study area.

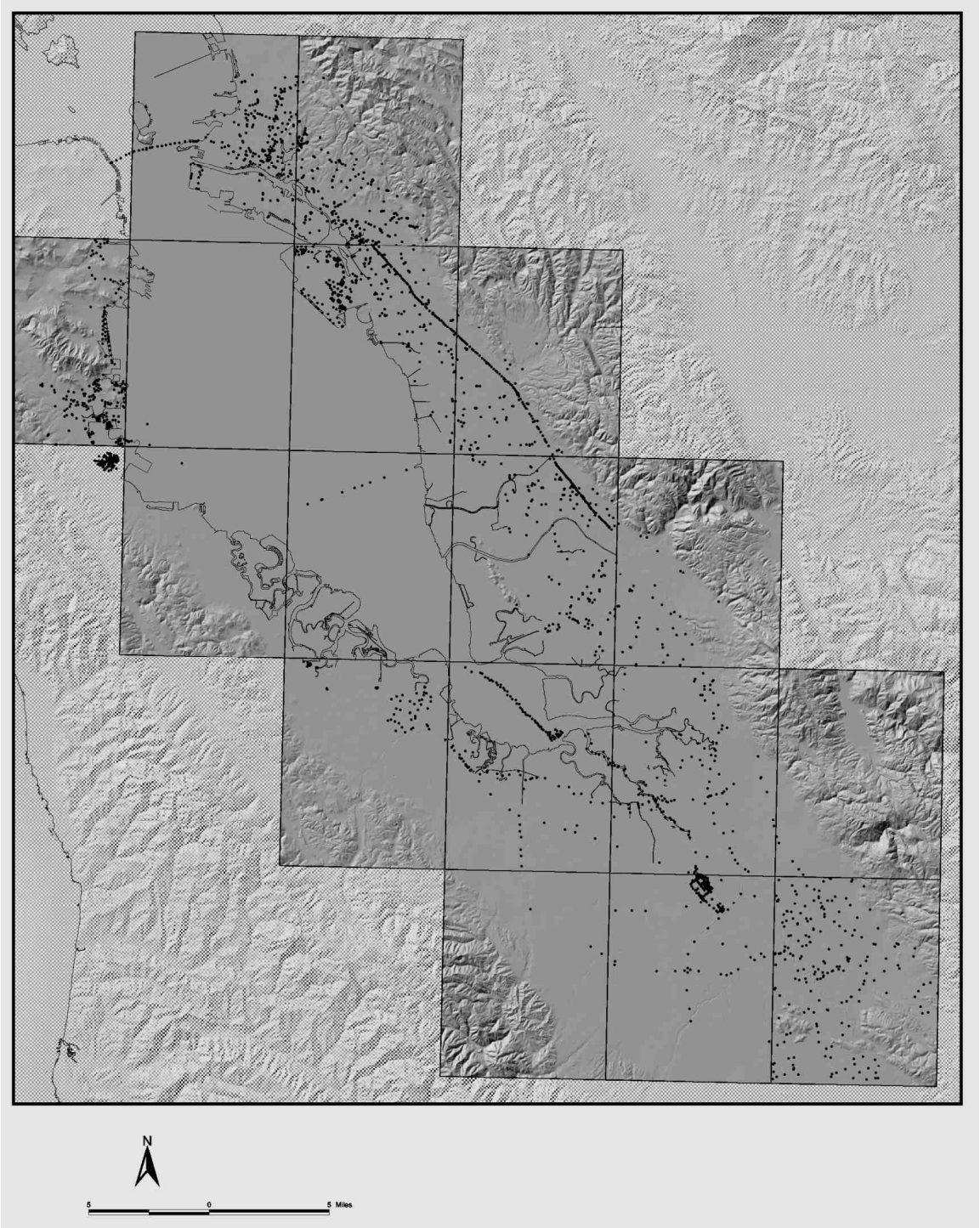


Figure 1. Map showing locations of borehole data compiled to date (boreholes shown as dots).

Helley (1990) contoured the top of Pleistocene deposits within Santa Clara Valley using CALTRANS geotechnical borings. Helley's map has contributed to the understanding of the subsurface structure of the Santa Clara Valley and has since been used to estimate the thickness of liquefiable sediments for a local liquefaction hazard evaluation (e.g. Powers

et al., 1992). The top of Pleistocene deposits typically is accompanied by a notable increase in penetrometer resistance that coincides with a marked reduction in liquefaction susceptibility with depth. Therefore the top of Pleistocene deposits represents the probable base of potentially liquefiable deposits within the Bay area. We have begun to refine Helley's existing map (Helley, 1990), by incorporating recent CALTRANS geotechnical data and data collected for construction (e.g. airport expansion, earthquake retrofits, new construction) and remediation sites (e.g. EPA Superfund sites, with assistance from the Santa Clara Water District).

**REPORTS PUBLISHED**

Preliminary results of our study were presented in poster form at the September 2000 Annual National Meeting of the Association of Engineering Geologists in San Jose, California. The reference for our abstract is:

*Hitchcock, C.S. and Helley, E.J., 2000, Geotechnical characterization of subsurface sediments, southern San Francisco Bay Area: AEG News, Program with abstracts, 2000 Annual Meeting, vol. 43, no. 4, p. 90*

Preliminary results of this study, including raw data and draft maps, are in ESRI Arcview 3.1 format. Compiled subsurface data is being compiled in Microsoft Excel 4.0 format.

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**References**

Helley, E.J., 1990, Preliminary contour map showing elevation of surface of Pleistocene alluvium under Santa Clara Valley, California, U.S.G.S. Open-file Report 90-633.

Powers, M.S., Wesling, J.R., Perman, R.C., and Disilvestro, L.A., 1992, Evaluation of liquefaction potential in San Jose, California: Unpublished Technical Report to U.S.G.S. NEHRP, San Francisco, Geomatrix Consultants.